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ENVIRONMENT

Fredrick Moore
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Subject:
Screening Air Monitoring
Martin Marietta Reduction Facility
The Dalles, Oregon
ORD 052 221 025

Date:
July 20, 2012

Contact:
Lynden Peters

Phone:
913-492-0900

Email:
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Our ref:
GP000677.2012

Dear Mr. Moore:

The purpose of this letter is to provide the Oregon Department of Environmental Quality (ODEQ) with details of screening-level air monitoring that was conducted July 7, 2012 at the site referenced above. The work was conducted by authorized and RCRA-trained personnel familiar with the site.

Background

The monitoring was conducted at the request of ODEQ personnel as an initial response to concerns from Region 10 of the United States Environmental Protection Agency (USEPA) that potentially explosive and/or toxic conditions could exist at the landfills. The Martin Marietta Reduction Facility site in The Dalles (Figure 1) includes two closed units; a Resource Conservation and Recovery Act (RCRA) landfill and a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) landfill. A Post Closure Care Permit issued by ODEQ is in place at the site; Lockheed Martin Corporation is the owner and ARCADIS is the operator of the landfills at the site. Both landfills are surrounded by chain link and barb wire fences. Access gates are locked at all times and entry restricted to authorized personnel only. Hazard warning and confined entry signs are appropriately displayed on features within and on the fence lines.

Objectives

The objectives of the initial air monitoring effort were to provide screening level measurements at locations on the RCRA and CERCLA landfills at the Lockheed

Martin site that would provide a current snapshot of gas concentrations to compare to those that had been measured during pilot tests conducted at the site from 2004 to 2007 (Table 3d) and previously reported.

Methods

Monitoring methods included the use of portable air sampling equipment. An RKI Eagle multi gas monitor was used to measure Lower Explosive Limit (LEL), methane (CH_4), oxygen (O_2), hydrogen sulfide (H_2S) and carbon dioxide (CO_2). A Multi Rae monitor was used to determine the presence of hydrogen cyanide (HCN) The HCN span gas used for calibration at the rental firm was 10 part per million (ppm). The range calibrated was 0 to 100 ppm, the instrument has an extended range function up to 500 ppm but those results would be more tentative. Since the Immediately Dangerous to Life or Health (IDLH) concentration is 50 ppm and the Time Weighted Average (TWA) is 4.7 ppm this range is usually appropriate for occupational monitoring. Both instruments were calibrated prior to use in this effort (Table 2). The RKI Eagle monitor was returned to the vendor it was purchased from for refurbishment and calibration prior to delivery to ARCADIS for this event and the Multi Rae was calibrated by the equipment provider prior to delivery to ARCADIS. A wind rose diagram for The Dalles municipal airport on July 7th is included as Appendix B.

No Sampling and Analysis Plan specific to this data collection was in place at the time the monitoring took place. Site activities were conducted in accordance with the Site Health and Safety Plan (HASP) which calls for field instrument measurements before confined space entry. Although confined space entry was not planned or performed during monitoring of the confined spaces (i.e., respective sumps at the RCRA and CERCLA landfills), all monitoring, including the vents and the area around them was conducted in accordance with the HASP. A Work Plan for additional vapor sampling that will include both screening level and extractive sampling methods is in preparation and will be submitted for agency review by July 25, 2012.

Locations

<u>RCRA Landfill</u>

The engineered cap on the RCRA landfill has gas relief vents at three locations on the top of the landfill, as shown on Figure 2. The inset on this figure shows details of the vent construction. Readings were collected at each of the 3 vents on the RCRA

landfill at the highest point within the vent, after removal of the vent cover (Fig. 2). Additional readings were collected at 5 feet above ground surface one foot upwind, one foot downwind, and at 5 feet above ground surface 5 feet upwind and 5 feet downwind. Cross wind data was also collected at 1 and 5 feet from each vent cap utilizing the same elevation criteria.

Three perimeter readings were also collected; one reading downwind and 2 subsequent readings approximately 100 feet laterally from the initial downwind sample location in each direction.

A reading was collected from within the casing of Monitor Well MW-5S, in the RCRA sump located in the RCRA utility building, and in the RCRA utility building. The RCRA utility building was vented as called for by the HASP by the opening of large doors before these measurements were taken.

Readings were also collected 6 inches off ground surface at the east cap drain, southeast cap drain, southwest cap drain, west cap drain, northwest cap drain, and northeast cap drain on the RCRA landfill.

CERCLA Landfill

Readings at the CERCLA landfill were collected at Lift Stations 1and 2, and at Manholes 2, 3, and 4 (Fig. 3). Readings were collected at 6-8 feet inside the manholes by lowering the instrument tubing into the sump. Readings were also collected from 1 foot above ground surface and laterally 1 foot from the manhole in all four cardinal directions and at 5 feet above ground surface, 5 feet laterally from the manhole, in all directions, and 1 foot above open manholes and lift stations.

All sampling was conducted on July 7, 2012.

Results

Sampling results are detailed on Tables 1a and 1b. In general, the results of sampling showed:

- Methane, hydrogen sulfide and hydrogen cyanide were detected within the vents; however, some of the reported concentrations were in excess of the calibration limits for the field instrumentation. Carbon dioxide was elevated above atmospheric levels in one vent and was near atmospheric levels in the

other two vents. Oxygen was below atmospheric composition in all three vents. The highest LEL reading within the vents was 59% of the lower explosive limit. All measurements of these gases outside of the vents met screening levels.

- In the RCRA sump, the oxygen level was reduced from 20.9 to 20.4%. No oxygen depletion was detected in the RCRA building.

- At the CERCLA landfill lift stations and manholes gases detected were H_2S, CO_2 and HCN. No CH_4 was detected and the LEL registered zero. Outside the lift stations and manholes at 1 foot and 5 feet above ground measurement levels, only oxygen at normal atmospheric levels was detected. Since atmospheric air was used to zero the CO2 sensor of the RKI Eagle instrument the relatively constant atmospheric background of CO2 of 400 ppbv will be recorded as zero. Since the TWA for CO2 is 10,000 ppm the 400 ppbv ambient background is not particularly significant for normal occupational monitoring purposes. Readings were taken as close as 6 inches directly above the open manholes.

Conclusions

At the time of sampling, air monitoring for the constituents sampled indicated that the exterior work zones described did not present a health and safety concern. The site specific Health and Safety Plan as well as the appropriate Standard Operating Procedures describe proper personal protective equipment (PPE) and sampling procedures to be used during monitoring events.

Similarly, in recognition of the air quality conditions within the RCRA sump and CERCLA manholes and lift stations, confined entry permits are required prior to entry at these locations. Occasional site workers are prohibited from entry into these site features without following Occupational Safety and Health Administration (OSHA) confined entry permit procedures which include proper training, task documentation and confined space ventilation.

We hope that this information provides helpful information as air monitoring work plans are developed during the course of agency discussions regarding the site. We appreciated your assistance and direction developing the methods and locations of this screening-level monitoring effort.

Sincerely,

ARCADIS U.S., Inc.

Lynden Peters
Project Manager

Copies:
Harry Craig, R10, USEPA
Bill Bath, Lockheed Martin Corporation

Attachments:
Fig. 1 Site Location Map
Fig. 2 RCRA Landfill
Fig. 3 CERCLA Landfill
Table 1a. RCRA Landfill Air Monitoring
Table 1b. CERCLA Landfill Air Monitoring
Table 2 Instrument Range Data
Table 3d. RCRA Landfill Air Monitoring and CO_2 Injection
Appendix A – Factory Instrument Calibration
Appendix B – The Dalles wind rose – July 7, 2012

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Tables

Table 1a. RCRA LANDFILL AIR MONITORING
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppmv)	HCN (ppm)	Wind speed for entire event at 1-3 mph, changing directions.
		Vent 1								
7/7/12	10:37	Source	45	84	13	56	0.03	300	105	Readings inside vent. CH4 and HCN over limit.
	10.:45	Worker Exposure 1U	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, one foot upwind.
	10:47	Worker Exposure 1D	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, one foot downwind.
	10:50	Worker Exposure 5U	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, five feet upwind.
	10:54	Worker Exposure 5D	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, five feet downwind.
	10:56	Cross wind 1N	ND	ND	20.9	ND	ND		ND	Cross wind - 1 and 5 ft crosswind, same criteria.
	10:59	Cross wind 1S	ND	ND	20.9	ND	ND		ND	
	11:02	Cross wind 5N	ND	ND	20.9	ND	ND		ND	
	11:05	Cross wind 5S	ND	ND	20.9	ND	ND		ND	
		Vent 2								
7/7/12	10:10	Source	52	96	12.5	57	0.04	400	93.4	Readings inside vent. CH4 and HCN over limit.
	10:16	Worker Exposure 1U	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, one foot upwind.
	10:18	Worker Exposure 1D	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, one foot downwind.
	10:21	Worker Exposure 5U	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, five feet upwind.
	10:25	Worker Exposure 5D	ND	ND	20.9	ND	ND		ND	5 feet elevation above ground, five feet downwind.
	10:27	Cross wind 1N	ND	ND	20.9	ND	ND		ND	Cross wind - 1 and 5 ft crosswind, same criteria.
	10:29	Cross wind 1S	ND	ND	20.9	ND	ND		ND	
	10:31	Cross wind 5N	ND	ND	20.9	ND	ND		ND	
	10:33	Cross wind 5S	ND	ND	20.9	ND	ND		ND	

Source Inside vent cap at elbow.

LEL - Lower Explosive Limit.

CH_4 - Methane.

O_2 - Oxygen. Ambient concentration typically 20.9 percent.

H_2S - Hydrogen Sulfide.

HCN - Hydrogen Cyanide.

CO_2 - Carbon Dioxide. Ambient concentrations typically 300-600 ppm.

Notes: This rapid response air monitoring, done at the request of ODEQ (Fredrick Moore) was not conducted using an approved Sampling and Analysis Plan (SAP) but was consistent with the air monitoring methodologies in the Site HASP.

Manufacturer's instructions were followed for use of portable air monitoring equipment and both monitors were calibrated prior to use.

The HCN monitor was calibrated to a range of 0 - 100 ppm. The extended range is 100 - 500 ppm, but this data is outside the calibration limits.

The CO2 monitor was zeroed to ambient conditions. The results do not include ambient CO2 concentrations.

Table 1a. RCRA LANDFILL AIR MONITORING
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppmv)	HCN (ppm)	Wind speed for entire event at 1-3 mph, changing directions.
		Vent 3								
7/7/12	9:25	Source	59	94	12.4	60	0.08	800	84	Readings inside vent.CH4 and HCN over limit.
	9:30	Worker Exposure 1U	ND	ND	20.9	ND	0.00		ND	5 feet elevation above ground, one foot upwind.
	9:34	Worker Exposure 1D	ND	ND	20.9	ND	0.00		ND	5 feet elevation above ground, one foot downwind.
	9:40	Worker Exposure 5U	ND	ND	20.9	ND	0.00		ND	5 feet elevation above ground, five feet upwind.
	9:42	Worker Exposure 5D	ND	ND	20.9	ND	0.00		ND	5 feet elevation above ground, five feet downwind.
	9:44	Cross wind 1N	ND	ND	20.9	ND	0.00		ND	Cross wind - 1 and 5 ft crosswind, same criteria.
	9:46	Cross wind 1S	ND	ND	20.9	ND	0.00		ND	
	9:49	Cross wind 5N	ND	ND	20.9	ND	0.00		ND	
	9:53	Cross wind 5S	ND	ND	20.9	ND	0.00		ND	
7/7/12	9:59	**Perimeter 1**	ND	ND	20.9	ND	0.00		ND	Downwind.
	10:03	**Perimeter 2**	ND	ND	20.9	ND	0.00		ND	Move approximately 100 feet each direction.
	10:08	**Perimeter 3**	ND	ND	20.9	ND	0.00		ND	Move approximately 100 feet each direction.
	11:15	MW-5S	ND	ND	20.9	ND	0.00		ND	In casing.
	11:35	RCRA Sump	ND	ND	20.4	ND	0.20	2,000	ND	VOC result = 0.7.
	11:41	RCRA Shack	ND	ND	20.9	ND	0.00		ND	
		On Landfill								
7/7/12	11:50	East Cap Drain	ND	ND	20.9	ND	ND		ND	6 inches off ground, one-half way up slope of LF
	11:55	SE Cap Drain	ND	ND	20.9	ND	ND		ND	at all cap readings.
	12:00	SW Cap Drain	ND	ND	20.9	ND	ND		ND	
	12:05	West Cap Drain	ND	ND	20.9	ND	ND		ND	
	12:12	NW Cap Drain	ND	ND	20.9	ND	ND		ND	
	12:18	NE Cap Drain	ND	ND	20.9	ND	ND		ND	

Source Inside vent cap at elbow.

LEL - Lower Explosive Limit.

CH_4 - Methane.

O_2 - Oxygen. Ambient concentration typically 20.9 percent.

H_2S - Hydrogen Sulfide.

HCN - Hydrogen Cyanide.

CO_2 - Carbon Dioxide. Ambient concentrations typically 300-600 ppm.

Notes: This rapid response air monitoring, done at the request of ODEQ (Fredrick Moore) was not conducted using an approved Sampling and Analysis Plan (SAP) but was consistent with the air monitoring methodologies in the Site HASP.

The HCN monitor was calibrated to a range of 0 - 100 ppm. The extended range is 100 - 500 ppm, but this data is outside the calibration limits.

The CO2 monitor was zeroed to ambient conditions. The results do not include ambient CO2 concentrations.

Table 1b. CERCLA LANDFILL AIR MONITORING
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppmv)	HCN (ppm)	Wind speed for entire event at 1-3 mph, changing directions.
		Lift Station 1								
7/7/12	13:05	Source	ND	ND	12.9	ND	3.18	(alarm)	11	6 - 8 feet inside manhole, VOC = 1.9.
	13:10	Worker Exposure 1	ND	ND	20.9	ND	ND		ND	1 ft above ground, 1 ft from manhole, all directions.
	13:15	Worker Exposure 5	ND	ND	20.9	ND	ND		ND	5 ft above ground, 5 ft from manhole, all directions.
	13:20	Above open manhole	ND	ND	20.9	ND	ND		ND	1 foot above open manhole.
		Lift Station 2								
7/7/12	13:35	Source	ND	ND	19.5	ND	0.92	(alarm)	ND	6 - 8 feet inside manhole.
	13:45	Worker Exposure 1	ND	ND	20.9	ND	ND		ND	1 ft above ground, 1 ft from manhole, all directions.
	13:54	Worker Exposure 5	ND	ND	20.9	ND	ND		ND	5 ft above ground, 5 ft from manhole, all directions.
	14:05	Above open manhole	ND	ND	20.9	ND	ND		ND	1 foot above open manhole.

Source Inside manhole.

LEL - Lower Explosive Limit.

CH_4 - Methane.

O_2 - Oxygen. Ambient concentration typically 20.9 percent.

H_2S - Hydrogen Sulfide.

HCN - Hydrogen Cyanide.

CO_2 - Carbon Dioxide. Ambient concentrations typically 300-600 ppm.

Notes: This rapid response air monitoring, done at the request of ODEQ (Fredrick Moore) was not conducted using an approved Sampling and Analysis Plan (SAP) but was consistent with the air monitoring methodologies in the Site HASP.

Manufacturer's instructions were followed for use of portable air monitoring equipment and both monitors were calibrated prior to use.

The HCN monitor was calibrated to a range of 0 - 100 ppm. The extended range is 100 - 500 ppm, but this data is outside the calibration limits.

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Table 1b. CERCLA LANDFILL AIR MONITORING
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppmv)	HCN (ppm)	Wind speed for entire event at 1-3 mph, changing directions.
		Manhole 2	0	0	20.1	0	0.24		0	
7/7/12	14:15	Source	0	0	20.9	0	0.00		0	6 - 8 feet inside manhole.
	14:20	Worker Exposure 1	0	0	20.9	0	0.00		0	1 ft above ground, 1 ft from manhole, all directions.
	14:24	Worker Exposure 5	0	0	20.9	0	0.00		0	5 ft above ground, 5 ft from manhole, all directions.
	14:30	Above open manhole	0	0	20.9	0	0.00		0	1 foot above open manhole.
7/7/12	15:20	**Manhole 3**	0	0	20.9	0.21	0.00		0	4 feet inside manhole.
		Manhole 4								
7/7/12	14:42	Source	0	0	19.4	14	0.70	(alarm)	191	6 - 8 feet inside manhole. HCN over limit.
	14:48	Worker Exposure 1U	0	0	20.9	0	0.00		0	1 ft above ground, 1 ft from manhole, all directions.
	14:58	Worker Exposure 1D	0	0	20.9	0	0.00		0	5 ft above ground, 5 ft from manhole, all directions.
	15:04	Worker Exposure 5U	0	0	20.9	0	0.00		0	1 foot above open manhole.

Source Inside manhole.

LEL - Lower Explosive Limit.

CH_4 - Methane.

O_2 - Oxygen. Ambient concentration typically 20.9 percent.

H_2S - Hydrogen Sulfide.

HCN - Hydrogen Cyanide.

CO_2 - Carbon Dioxide. Ambient concentrations typically 300-600 ppm.

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Manufacturer's instructions were followed for use of portable air monitoring equipment and both monitors were calibrated prior to use.

The HCN monitor was calibrated to a range of 0 - 100 ppm. The extended range is 100 - 500 ppm, but this data is outside the calibration limits.

The CO2 monitor was zeroed to ambient conditions. The results do not include ambient CO2 concentrations.

Table 2. Instrument Range and Manufacturer's Stated Accuracy
LMC Site, The Dalles, Oregon

RKI Eagle		
Gas	Measuring	Accuracy
Oxygen (O2)	DL - 40% Vol.	± 0.5% O2
Hydrogen Sulfide (H2S)	DL - 1 ppm	± 10% of reading or ± 5% of full scale
	DL - 30 ppm	
Carbon Dioxide (CO2)	DL - 5,000 ppm	± 5% of reading or ± 2% of full scale
	DL - 10,000 ppm	
	DL - 5% Vol.	
	DL - 20% Vol.	
	DL - 60% Vol.	
Methane (CH4)	DL - 100 % LEL	± 5% of reading or ± 2% of full scale
	DL - 30% Vol.	
MultiRae		
Hydrogen Cyanide (HCN)	DL - 100 ppm	± 2 ppm or 10% of the reading .

DL = Detection Limit (calibration data included as Appendix A)

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
9/1/04	12:50	Vent 1		>50,000	19.1	100	0.00		235	5			Notes from Bob Schwartz.
		Vent 2		>50,000	13.1	>100	0.00		243				"spike" on HCN. Oxygen average is 15.0.
		Vent 3	>100		12.8	>100	0.00		976				Spiked at 976, then dropped to zero
		Sump		330	20.9	0	0.01	100	0				
9/1/04	16:35	Vent 1		26,000	20.9	5.2	0.00		235				Field note - numbers fluctuate throughout readings.
	16:52	Vent 1		>50,000	20.9	39.5	0.00		6.9				
	16:52	Vent 2		>50,000	13.1	>100	0.00		243				
		Vent 3	>100		18.9	>100	0.00						Third of three separate rounds of background air monitoring.
		Vent 3	>100		15.2	>100	0.00						Variations indicate "bubbles" or pockets of air contaminants trapped in
		Vent 3	>100		12.8	>100	0.00		976				upper bend of vent pipe.
		Sump		330	20.9	0	0.10	1,000	0				
9/2/04	8:25	Vent 1	57%		20.9	55-60	0.00		0				
		Vent 2	45%	200	20.8	>100	0.04	400	0				
		Vent 3	>100		18.8	>100	0.04	400	0				
9/2/04											2	800	Begin CO2 injection. Gas to Vents 2 and 3 by 10:30.
9/3/04	10:30	Vent 2	>100		8.0	>100	5.00	50,000					
9/3/04											2	1,600	Third tank in 2 hours. Fourth almost empty by 16:30.
9/7/04											1	2,000	Nothing injected since Fri. Last one of five bottles injected today.
Notes:	All gas readings taken prior to injecting CO2. No air data for Vent 1 after 9/7/04 (connected to injection system).												
9/8/04	13:10	Vent 2	>100		10.3	>100	>5.00	>50,000	0				O2 falling, CO2 at max when H2S exceeded sensor range.
		Vent 3	>100		12.2	>100	>5.00	>50,000	0				O2 falling, CO2 at max when H2S exceeded sensor range.
		Sump	0		2.9	0	0.04	400	0				Suspected typo on O2 reading. All other O2 levels are in 18 to 21 range.
9/8/04										2	1	2,400	Bottle cracked at 13:05, still discharging at 16:45.
9/9/04											1	2,800	
9/10/04										5	2	3,600	Open valves on two bottles (have splitter), left site. Both empty next day.
9/11/04											1	4,000	System froze up during day. Shut off one bottle at 16:30.
9/12/04											1	4,400	Started bottle at 7:00, still emptying at 11:30.
9/14/04											1	4,800	Last of 12 bottles (4800 lbs) into landfill.
9/15/04	10:00	Vent 2	0		20.9	0	0.04	400	0				
		Vent 3	0		20.9	0	0.06	600	0				
		Sump	0		20.9	0	0.02	200	0				
9/22/04	10:30	Vent 1	>100		4.1	>100			0				All three vents exceeded range for H2S and / or CH4. O2 still falling.
		Vent 2	>100		10.0	>100			0				
		Vent 3	>100		16.8	>100			0				
		Sump	0		18.3	0	0.84	8,400	0				

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	CO_2 (ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
9/29/04	15:45	Vent 1	>100		8.2	>100	2.00	20,000	976				All three vents exceeded range for H2S and / or CH4. O2 still falling and
		Vent 2	>100		9.0	>100	1.80	18,000	976				CO2 rising. Assume HCN over 999 limit.
		Vent 3	>100		9.2	>100	2.20	22,000	976				
		Sump	0		20.9	0	0.16	1,600	0				
10/6/04	12:25	Vent 1	>100		7.6	>100			976				All three vents exceeded range for H2S and / or CH4. O2 still falling and
		Vent 2	>100		9.2	>100			976				CO2 rising. Assume HCN over 999 limit.
		Vent 3	>100		9.9	>100			976				
		Sump	0		20.8	0	0.14	1,400	0				
10/6/04										2	1	5,200	Re-start CO2 injection at 2 bottles per week.
10/7/04											1	5,600	Second bottle opened at 12:30 and drained by 17:00.
10/13/04	10:35	Vent 2	>100		10.9	>100	5.00	50,000	-				HCN monitor sent back.
		Vent 3	>100		5.8	>100	4.20	42,000	-				
		Sump	0		20.9	0	0.40	4,000	-				
10/13/04										2	2	6,400	Open first bottle 14:05 - empty by 17:10. Switch to second bottle.
10/20/04	13:05	Vent 2	>100		1.4	>100	5.00	50,000	-				Oxygen level still falling.
		Vent 3	>100		2.2	>100	5.00	50,000	-				Oxygen level still falling.
		Sump	0		20.9	0	0.06	600	-				Near ambient levels for all gases.
10/20/04										2	1	6,800	Two bottles CO2 delivered.
10/21/04											1	7,200	
10/27/04	11:17	Vent 2	>100		1.0	>100	5.00	50,000	-				Oxygen level still falling.
		Vent 3	>100		3.1	>100	5.00	50,000	-				Oxygen level still falling.
		Sump	0		20.9	0	0.00	0	-				
10/27/04										2	2	8,000	One bottle 10/27 and one 10/29/04 (started 8:30 AM).
11/4/04	8:00	Vent 2	>100		0.6	>100	5.00	50,000	-				Four bottles CO2 delivered on 11/3/04.
		Vent 3	>100		2.7	>100	5.00	50,000	-				
		Sump	0		20.9	0	0.02	200	-				
11/4/04										4	2	8,800	One bottle 11/4 and one 11/5/04 (started 11:30 AM).
11/10/04	7:30	Vent 2	0		20.9	0	0.00	0	-				
		Vent 3	0		20.9	0	0.00	0	-				
		Sump	0		20.9	0	0.02	200	-				
11/10/04											2	9,600	One bottle 11/10 and one 11/12/04 (started 7:15 AM).
11/17/04	14:50												
11/18/04	8:45	Vent 2	0		20.9	0	0.00	0	-				
		Vent 3	0		20.9	0	0.00	0	-				
		Sump	0		20.9	0	0.00	0	-				

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
11/18/04										2	2	10,400	One bottle 11/18 and one 11/22/04 (started 9:30 AM).
11/24/04	8:45	Vent 2	0		20.9	0	0.00	0	-				
		Vent 3	0		20.9	0	0.00	0	-				
		Sump	0		20.9	0	0.00	0	-				
11/24/04										4	1	10,800	One bottle 11/24 and one 11/29/04 (started 8:45 AM).
11/29/04											1	11,200	Start second bottle.
12/2/04	9:55	Vent 2	>100		0.3	>100	5.00	50,000					
		Vent 3	>100		0.2	>100	5.00	50,000					
		Sump	0		20.9	0	0.00	0					
12/6/04											2	12,000	One bottle injected 12/02 and one 12/06/04.
12/8/04	14:10	Vent 2	>100		1.8	>100	5.00	50,000		2			Two bottles CO2 delivered.
		Vent 3	>100		2.1	>100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	2		19.0	0	0.44	4,400					Strong ammonia smell in sump shack.
12/12/04											2	12,800	One bottle injected 12/08 and one 12/12/04.
12/15/04	12:30	Vent 2	>100		0.8	>100	5.00	50,000					
		Vent 3	>100		3.8	>100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.9	0	0.00	0					No odor in sump shack.
12/15/04										2	2	13,600	Two bottles CO2 delivered. One injected 12/15 and one 1220/04.
12/22/04	8:30	Vent 2	>100		1.2	>100	5.00	50,000					Collect sample for KO88 analysis.
		Vent 3	>100		2.2	>100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.9	0	0.00	0		2	2	14,400	Two bottles CO2 delivered. One injected 12/22 and one 12/12/27.
12/29/04	12:30	Vent 2	>100		1.0	>100	5.00	50,000					No CO2 delivery - blizzard conditions on highway.
		Vent 3	>100		3.9	>100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.9	0	0.00	0					
1/3/05										4	2	15,200	Four bottles CO2 delivered. One injected 01/03 and one 01/04/05.
1/5/05	13:30	Vent 2	100		14.8	100	5.00	50,000					
		Vent 3	100		0.1	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.9	0	0.02	200			2	16,000	One bottle injected 01/05 and one 01/10/05.
1/12/05	12:30	Vent 2		100	1.4	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		2.8	100	5.00	50,000					
		Sump	0		20.9	0	0.02	200					
1/16/05										4	2	16,800	Four bottles CO2 delivered. One injected 01/16 and one 01/17/05.
1/19/05	8:50	Vent 2	100		0.5	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		5.4	100	5.00	50,000			2	17,600	One bottle injected 01/19 and one 01/24/05.
		Sump	0		20.9	0	0.16	1,600					

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
1/26/05	12:59	Vent 2	100		0.4	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		3.0	100	5.00	50,000		4			
		Sump	2		20.7	3	0.14	1,400					Building had slight amonia smell, ventilated 5 minutes before air sample.
											4	19,200	Bottles injected 01/26, 01/31, 02/02, and 02/07/05.
2/9/05	13:05	Vent 2	100		0.4	100	5.00	50,000		4	1	19,600	
		Vent 3	100		7.7	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.7	100	0.22	2,200					Building had slight amonia smell, ventilated 10 minutes before sampling.
2/14/05	14:50	Vent 2	100		0.5	100	5.00	50,000			1	20,000	
		Vent 3	100		3.2	100	5.00	50,000					
		Sump	0.2		20.8	3.5	0.08	800					
											2	20,800	One bottle injected 02/16 and one 02/21/05.
2/23/05	12:30									4			Took delivery of four new bottles of CO2, removed 4 empties
2/24/05	14:20	Vent 2	100		0.5	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		2.3	100	5.00	50,000			1	21,200	
		sump	2		15.5	0	1.22	12,200					Vented building 10 min. prior to sampling.
2/28/05	9:35										1	21,600	
3/9/05										2			Took delivery of two new bottles of CO2, removed 2 empties.
3/19/05	10:45	Vent 2	100		8.4	100	5.00	50,000					
		Vent 3	100		6.3	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Sump	0		20.9	0	0.00	0			1	22,000	
3/21/05											1	22,400	
3/23/05	13:20	Vent 2	100		1.1	100	5.00	50,000			1	22,800	
		Vent 3	100		6.7	100	5.00	50,000					
		sump	0		20.9	0	0.18	1,800					
3/28/05	8:35											22,800	Bottle still full (frozen), re-opened valve.
3/30/05	13:20	Vent 2	0		20.9	0	0.00	0		3	1	23,200	Driver delivered 3, removed 3. Open last of previous bottles at 08:30.
		vent 3	0		20.9	0	0.00	0					Vented building 10 min. prior to sampling.
		sump	0		20.9	0	0.00	0			1	23,600	
4/1/05	8:40										2	24,400	One bottle injected 04/01 and one 04/04/05.
													W. Harmon on vacation - 4/9-4/23
4/13/05										4			Four bottles delivered.
4/18/05	13:30										3	25,600	Bottles injected 04/18, 04/19, and 04/20//05.
4/20/05										3	1	26,000	Norco delivered .3 more bottles. Full one from earlier load injected 04/25.
4/27/05	14:00	Vent 2	100		0.4	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		2.1	100	5.00	50,000					

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	(ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
		sump	0		20.1	3	0.08	800			1	26,400	
4/29/05	10:05										2	27,200	One bottle injected 04/29 and one 05/02/05.
5/4/05	12:30	Vent 2	48		19.1	100	1.50	15,000		4	1	27,600	Four bottles delivered.
		Vent 3	100		15.6	100	5.00	50,000					
		sump	1		20.9	0	0.02	200					
5/5/05	12:35										1	28,000	Sample sump. Open second bottle.
5/11/05	16:40	Vent 2	0		20.9	0	0.00	0			1	28,400	
		Vent 3	0		20.9	0	0.00	0					
		sump	0		20.9	0	0.00	0					
5/16/05											1	28,800	
5/18/05	12:15	Vent 2	0		20.9	0	0.02	200		4	1	29,200	NORCO delivered 4 bottles. Open first.
		Vent 3	0		20.9	0	0.00	0					
		sump	0		20.9	0	0.04	400					
5/23/05											1	29,600	
5/25/05	14:40	Vent 2	100		0.5	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		2.5	100	5.00	50,000					
		sump	0		20.9	0	0.04	400			1	30,000	
5/27/05	17:50										1	30,400	
6/1/05	17:45	Vent 2	100		0.4	100	5.00	50,000		4	1	30,800	NORCO delivered 4 bottles. Open first.
		Vent 3	100		2.7	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		sump	0		20.9	3.5	0.08	800					
6/4/05											1	31,200	
6/8/05	17:40	Vent 2	0		20.9	0	0.00	0					
		Vent 3	0		20.9	0	0.06	600					
		sump	0		20.9	0	0.06	600			1	31,600	
6/11/05											1	32,000	
6/15/05	9:15	Vent 2	0		20.9	0	0.00	0		4			NORCO delivered 4 bottles.
		Vent 3	0		20.9	0	0.00	0					
		sump	0		20.9	0	0.02	200			1	32,400	
6/17/05	17:00										1	32,800	
6/22/05	18:11	Vent 2	100		2.1	100	5.00	50,000					Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		3.2	100	5.00	50,000					
		sump	0		20.9	0	0.08	800			1	33,200	
6/24/05	8:45										1	33,600	
6/29/05	10:05	Vent 2	100		0.1	100	5.00	50,000		4			Sensor failure, both vents. Oxygen levels still falling.

Table 3d. RCRA LANDFILL AIR MONITORING AND CO_2 INJECTION - Gas Phase Study
LMC Site, The Dalles, Oregon

Date	Time	Location	Air Monitoring							CO_2 Tanks			Notes
			LEL (%)	CH_4 (ppm)	O_2 (%)	H_2S (ppm)	CO_2 (%)	CO_2 (ppm)	HCN (ppm)	Tanks Delivered	Tanks Injected	Total (lbs)	
		Vent 3	100		1.4	100	5.00	50,000					
		sump	3		18.7	0	0.30	3,000			1	34,000	
7/6/05	11:05	Vent 2	100		1.2	100	5.00	50,000			1	34,400	Sensor failure, both vents. Oxygen levels still falling.
		Vent 3	100		3.8	100	5.00	50,000					
		sump	0		18.8	0	0.68	6,800					
										2	4	36,000	
8/24/05	9:40	Vent 3							0.0				Stop injection of CO2. Conduct final air monitoring (including HCN).
	9:46	Vent 3	3		21.2	0.0	0.0	0	0.0				
		Vent 2	100		15.4	100	5.0	50,000	994				
		Vent 1	3		21.2	0	0.0	0	0				
8/30/05													Install vacuum blower on Vent 1.
6/28/06		Vac Box	10		14.3	0	0.4	3,800					Monitored at Vent 1 blower exhaust.
7/16/06		background	0	0	20.9	0	0.0	0					
	11:36	Vac Box	14	6,300	15.8	1	0.3	2,800					
	11:45	Vac Box	10	5,500	15.9	1	0.3	2,800					
		downwind		820									
3/16/07	11:00	Vac Box	34		12.5	2.5	0.12	1,200					
		Sump	1		19.9	0	0.08	800					

LEL - Lower Explosive Limit.
CH_4 - Methane.
O_2 - Oxygen. Ambient concentration typically 20.9 percent.
H_2S - Hydrogen Sulfide.
HCN - Hydrogen Cyanide.
CO_2 - Carbon Dioxide. Ambient concentrations typically 300-600 ppm.

Notes:
* > Indicates the concentration being measured exceeded the range of values for the air monitor. Maximum measurable H2S for the RKI Eagle is 100 ppm. The sensor will fail at concentrations above 150 ppm, causing a "Sensor Failure" and automatic shut down of monitor with loss of readings.
* Variations in values indicate "bubbles" or pockets of air contaminants trapped in the vent piping elbow, and is typical of landfill gases. When vent caps left off for a short period of time during windy or breezy conditions, parameter concentrations in the pipe returned to ambient conditions.
* Each tank contains 400 lbs of liquid CO2.

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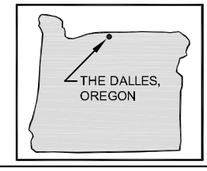
Figures

LEGEND

MW-41S CERCLA LANDFILL MONITORING WELL LOCATION

MW-37S RCRA LANDFILL MONITORING WELL LOCATION

LOCKHEED MARTIN CORPORATION OWNERSHIP



N

0 350 700 1050

APPROXIMATE SCALE IN FEET
1" = 700'

Drafter	M. HOEFER
Project Manager	K.W. SMITH
Task Manager	M. RISHER
Technical Review	M. RISHER / KW SMITH

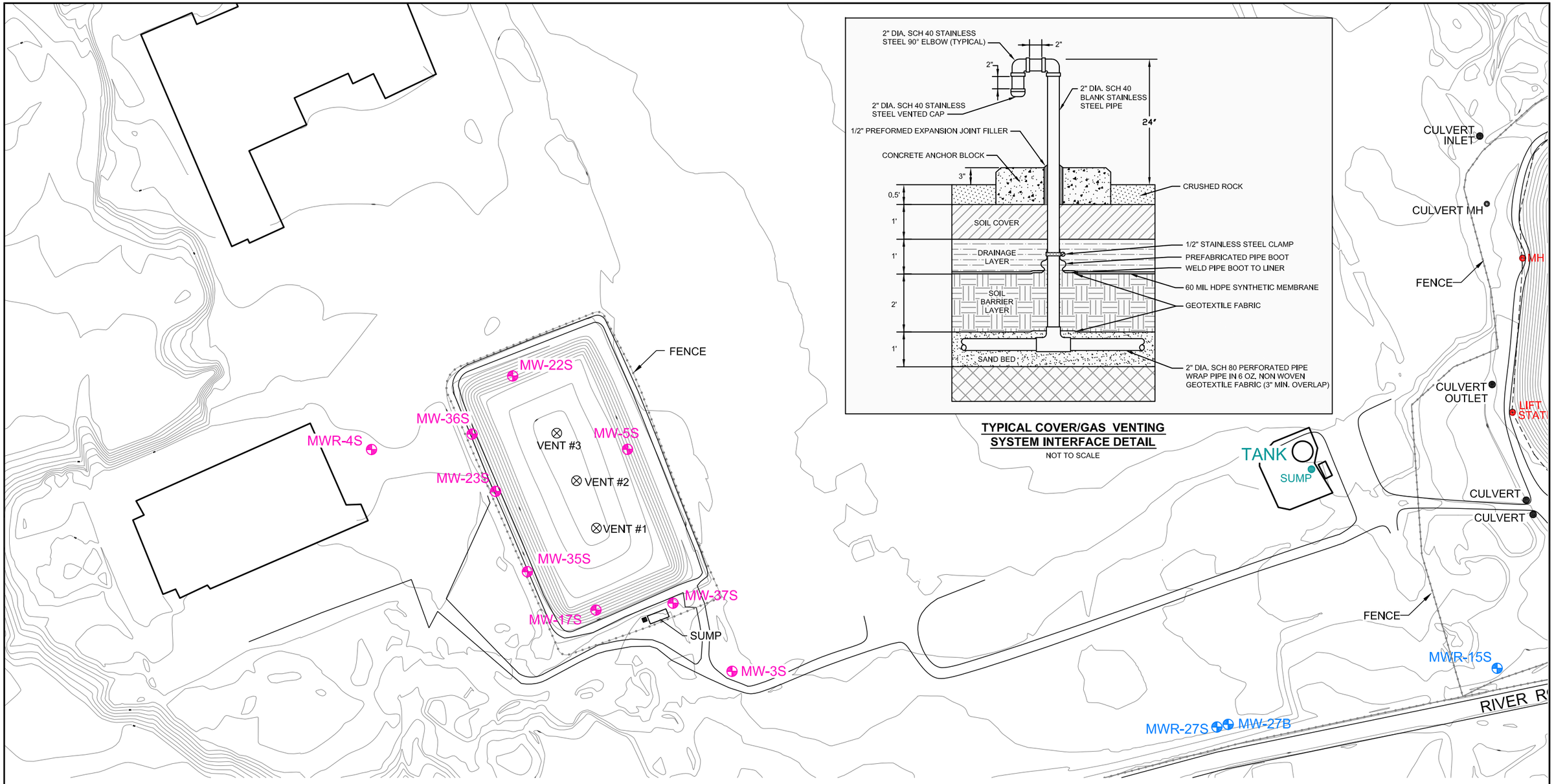
ARCADIS

ARCADIS U.S., Inc.
1610 B Street, Suite 100
Helena, MT 59601
Tel: 406-449-7001 Fax: 406-449-3063
www.arcadis-us.com

LOCKHEED MARTIN CORPORATION
SITE LAYOUT - FACILITIES AND PROJECT AREAS

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number	MH000986.0001
Drawing Date	12/03/10
Figure	1



TYPICAL COVER/GAS VENTING SYSTEM INTERFACE DETAIL

NOT TO SCALE

LEGEND

- MW-41S — CERCLA LANDFILL MONITORING WELL LOCATION
- MW-37S — RCRA LANDFILL MONITORING WELL LOCATION
- MH #4 — MANHOLE

N

0 100' 200' 300'

APPROXIMATE SCALE IN FEET
1" = 200'

Current Plotstyle : ByColor
Layout Tab: Fig 2

Date\Time : Fri, 29 Jun 2012 — 10:09am
Path\Name : C:\Mentors\LMC\COL0C-0487.dwg

Acad Version : R18.1s (LMS Tech)
User Name : MHoefer

Drafter	M. HOEFER
Project Manager	K.W. SMITH
Task Manager	M. RISHER
Technical Review	M. RISHER / K.W. SMITH

ARCADIS
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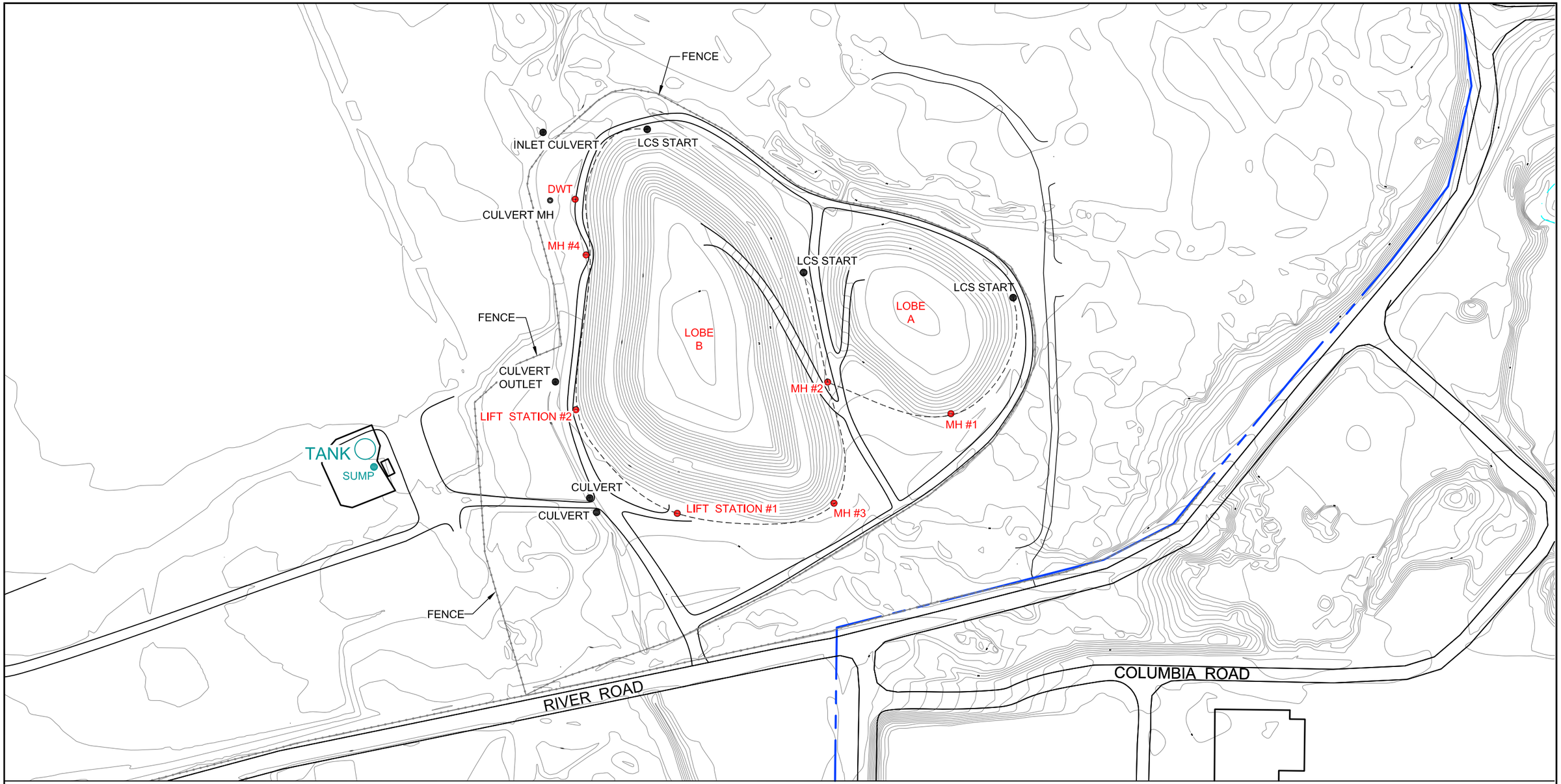
RCRA LANDFILL

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number	GP000677.0015
Drawing Date	06/28/12
Figure	2



LEGEND

MH #3 MANHOLE

N

0 100' 200' 300'

APPROXIMATE SCALE IN FEET
1" = 200'

Drafter	M. HOEFER
Project Manager	K.W. SMITH
Task Manager	M. RISHER
Technical Review	M. RISHER / K.W. SMITH

ARCADIS

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CERCLA LANDFILL

LOCKHEED MARTIN CORPORATION SITE
THE DALLES, OREGON

Project Number	GP000677.0015
Drawing Date	06/28/12
Figure	3

Acad Version : R18.1s (LMS Tech) Date\Time : Fri, 29 Jun 2012 — 11:18am
User Name : MHoefer Path \Name : C:\Montana\LM\COL0C-0486.dwg
Current Plotstyle : ByColor
Layout : Tab: Fig 3

Appendix A

Factory Instrument Calibration

INSTRUMENT CALIBRATION REPORT

Pine Environmental Services, Inc.
92 North Main St, Building 20
Windsor, NJ 08561
Toll-free: (800) 301-9663

Pine Environmental Services, Inc.

Instrument ID 8449
Description MultiRae Plus
Calibrated 6/29/2012

Test Instruments Used During the Calibration **(As Of Cal Entry Date)**

Test Standard ID	Description	Manufacturer	Model Number	Serial Number / Lot Number	Last Cal Date/ Opened Date	Next Cal Date / Expiration Date
NJ 4GAS GAL-412-16	4 GAS MIX	Pine Environmental Services, Inc.	GP12089	GAL-412-16		9/21/2012
NJ HCN 1206265	HCN 10 ppm	Pine Environmental Services, Inc.		1206265		9/30/2012
NJ ISO 0204FA11	NJ 100 PPM Isobutylene		100 ppm ISO	0204FA11		3/31/2015

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated Silas Saye

All instruments are calibrated by Pine Environmental Services, Inc. according to the manufacturer's specifications, but it is the customer's responsibility to calibrate and maintain this unit in accordance with the manufacturer's specifications and/or the customer's own specific needs.

Notify Pine Environmental Services, Inc. of any defect within 24 hours of receipt of equipment
Please call 866-960-7463 for Technical Assistance

INSTRUMENT CALIBRATION REPORT

Pine Environmental Services, Inc.
92 North Main St, Building 20
Windsor, NJ 08561
Toll-free: (800) 301-9663

Pine Environmental Services, Inc.

Instrument ID 8449
Description MultiRae Plus
Calibrated 6/29/2012

Manufacturer Rae Systems
Model Number PGM50
Serial Number/ Lot Number 095-517595
Location New Jersey
Department

State Certified
Status Pass
Temp °C 26.4
Humidity % 50

Calibration Specifications

Group # 1
Group Name HCN
Stated Accy Pct of Range
Range Acc % 3.0000
Reading Acc % 0.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
10.00 / 10.00	PPM	10.00	PPM	10.00	10.00	0.00%	Pass

Group # 2
Group Name H2S
Stated Accy Pct of Range
Range Acc % 3.0000
Reading Acc % 0.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
25.00 / 25.00	PPM	25.00	PPM	25.00	25.00	0.00%	Pass

Group # 3
Group Name Methane
Stated Accy Pct of Range
Range Acc % 3.0000
Reading Acc % 0.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
50.00 / 50.00	%LEL	50.00	%LEL	50.00	50.00	0.00%	Pass

Group # 4
Group Name Oxygen
Stated Accy Pct of Range
Range Acc % 3.0000
Reading Acc % 0.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
20.90 / 20.90	%Volume	20.90	%Volume	20.90	20.90	0.00%	Pass

Group # 5
Group Name Isobutlyene
Stated Accy Pct of Reading
Range Acc % 0.0000
Reading Acc % 3.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
100.00 / 100.00	PPM	100.00	PPM	100.00	101.00	1.00%	Pass

DXP
THE INDUSTRIAL DISTRIBUTION EXPERTS

Quality Assurance: Gas Monitor

Manufacturer: RKI Model: Eagle
Serial Number: E48103

Sensor Type: ☒ Oxygen ☒ Comb.%LEL ☐ Comb.%GAS ☐ Comb.PPM
☒ Toxic(Specify) #1 CO2 #2 H2S Other:

Battery Type: 4 D Cells Voltage: 7.84 vDc Date Code: n/a

Alarms:					
Oxygen:	Low: 19.5%	High: 23.5%			
Combustible:	Low: 10%lel	High: 50%lel	PPM: ____	____ : ____	
Toxic #1	Low: 0.50%	High: 3.00%	TWA: 0.50%	STEL: 3.00%	
Toxic #2	Low: 10PPM	High: 30PPM	TWA: 10PPM	STEL: 15PPM	
Other:	Low: ____	High: ____	____ : ____	____ : ____	

Calibration Gases Used, Pre Calibration and Maximum Span Readings:

Oxygen:	Ambiant Air	20.9%	Pre:	18.9	%	Span: PASS	%
Combustible:	Methane	50%lel	Pre:	44	%lel	Span: PASS	%lel
Toxic #1	Carbon Dioxide	2.5%	Pre:	2.65	%	Span: PASS	ppm
Toxic #2	Hydrogen Sulfide	25PPM	Pre:	28	ppm	Span: PASS	ppm
Other:			Pre:			Span:	

Sensor Serial Number, Date Code, Expiration Date, And/Or CAL Gas Lot #:

Oxygen:	236060512ET	Cyl Lot # 2-082-20 Exp 04/2013
Combustible:	NC-6260B1 230219	Cyl Lot # 2-082-20 Exp 04/2013
Toxic #1	0807 DE-3113-1	Cyl Lot # 1268604 Exp FEB 2015
Toxic #2	226065144ES	Cyl Lot # 2-082-20 Exp 04/2013
Other:		

Check List:
☒ Is Calibration Sticker Filled Out and Attached?
☒ Is Unit Being Returned With All Accessories Received?
☒ Is Unit (and Accessories) Cleaned As Well As Possible?
☒ Are Any Other Forms, Certificates, Etc. Required?
☒ Have All Parts Used In Repair Been Recorded?
☐ If Not Being Repaired, Have All Parts Been Removed?

Approvals: ☐ FM ☐ MSHA ☐ UL ☒ CSA ☐ CE ☐ EX ☐ Commonwealth of Pennsylvania Other:

Notes: Replaced all 4 D cells, Bad O2 sensor, weak LEL sensor, Expired Oxygen snsor, and bad H2S sensor.

Last Seen:RKI Version:n/a

Technician: Dan Greenfield Date: Jun. 27, 12

1111 S. 27th St. Billings MT 59101
406-247-2050

Appendix B

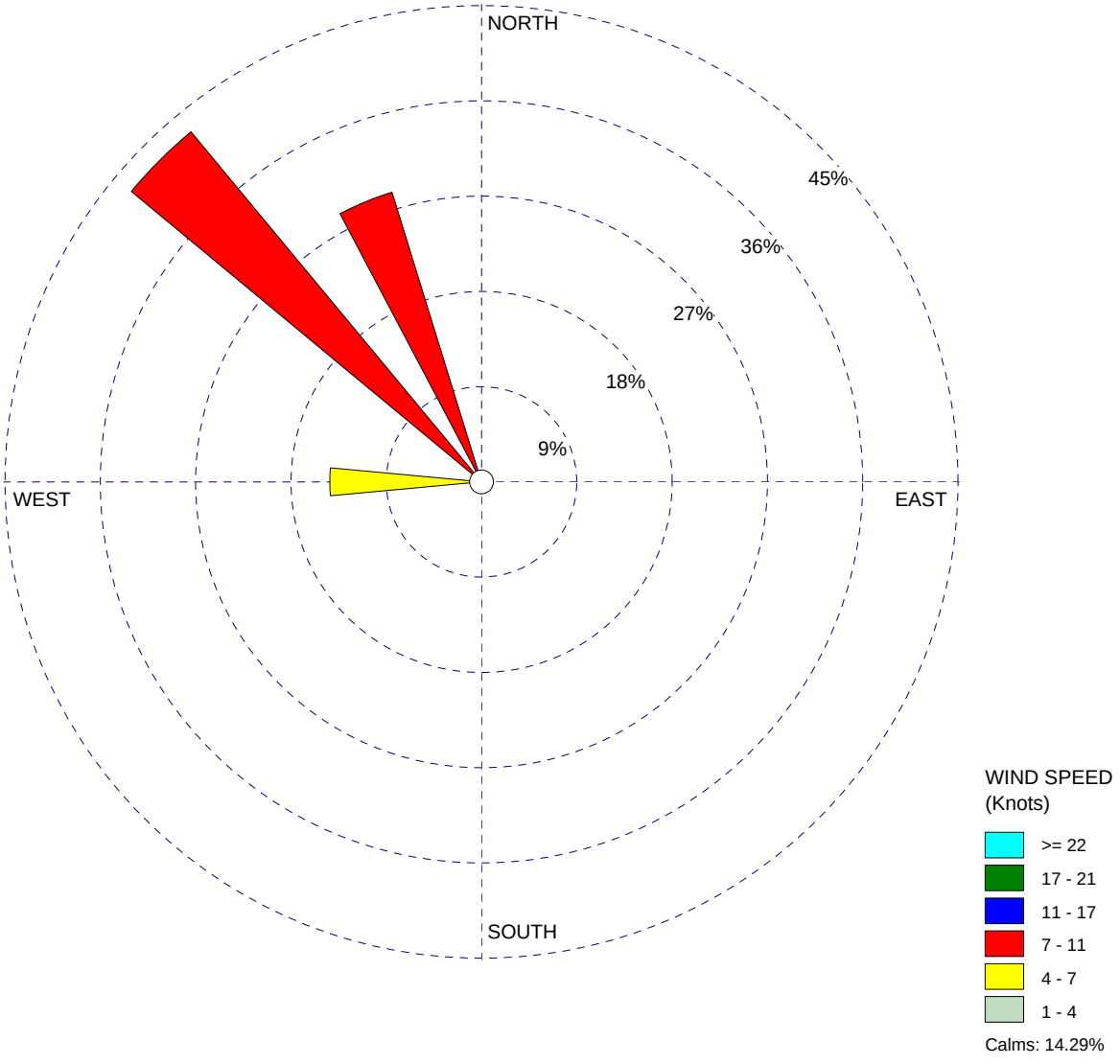
Wind Speed and Direction Data

WIND ROSE PLOT:

Station #KDLS

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 7/7/2012 - 10:00** **End Date: 7/7/2012 - 16:00**	COMPANY NAME: **Arcadis**	
		MODELER: **szou**	
	CALM WINDS: **14.29%**	TOTAL COUNT: **7 hrs.**	
	AVG. WIND SPEED: **7.29 Knots**	DATE: **7/17/2012**	PROJECT NO.: